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(54) **METHODS FOR MAKING COATING COMPOSITIONS HAVING PREDETERMINED VOC CONTENTS, METHODS FOR MAKING SYSTEMS FOR PRODUCING SUCH COATING COMPOSITIONS, AND TEMPERATURE ADJUSTERS FOR MAKING SUCH COATING COMPOSITIONS**

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(57) **ABSTRACT**

A method of making a coating composition includes selecting a temperature adjuster from a plurality of temperature adjusters based on an ambient temperature at which application of the coating composition is to occur. The temperature adjuster contains a resin and a solvent. The resin, the solvent, and/or amounts of the resin and the solvent are based on the ambient temperature. The temperature adjuster contains no less than about 1% solids and has no more than a predetermined VOC content. A paint is combined with the temperature adjuster. The paint contains a resin and a solvent and has no more than the predetermined VOC content. The temperature adjuster and the paint are mixed to form the coating composition, wherein the coating composition has no more than the predetermined VOC content.

19 Claims, No Drawings

METHODS FOR MAKING COATING COMPOSITIONS HAVING PREDETERMINED VOC CONTENTS, METHODS FOR MAKING SYSTEMS FOR PRODUCING SUCH COATING COMPOSITIONS, AND TEMPERATURE ADJUSTERS FOR MAKING SUCH COATING COMPOSITIONS

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority to U.S. Provisional Patent Application No. 61/889,346, filed Oct. 10, 2013, which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

The technical field generally relates to methods for making coating compositions, methods for making systems for producing coating compositions, and temperature adjusters for making coating compositions and more particularly relates to methods for making coating compositions that have predetermined VOC contents, methods for making systems for producing such coating compositions, and temperature adjusters for making the coating compositions.

BACKGROUND

Environmental concerns have resulted in government regulations of volatile organic compounds (VOCs) in paints and coatings. For example, in the United States, many states have passed or are considering passing legislation limiting VOCs in refinish basecoats to no more than 0.42 kilograms (kg) of VOCs/liter of paint (3.5 pounds of VOCs/gallon of paint). Other countries have or will follow suit. Compliance with these regulations is currently possible by using "exempt" solvents that are not included in the calculation of VOCs. VOC exempt solvents do not cause the formation of ground level ozone (smog), according to environmental chemists. Several of the more commercially useful VOC exempt solvents include acetone, methyl acetate, tertiary butyl acetate (TBAc), and P-chlorobenzotriflouride (PCBTF). Water also is considered an exempt solvent.

However, coatings made from these solvents are not always suitable for application, for example, by spraying, in all temperatures. During application of a coating composition, such as a refinish basecoat, it is preferable that the basecoat dry quickly but not so quickly that the basecoat does not have time to flow evenly over the vehicle. There are a limited number of exempt solvents and they do not necessarily have evaporation rates that make them suitable for use in all temperature ranges. For example, if the refinish basecoat is to be sprayed on an automobile at low temperatures, for example, at temperatures in the range of below 21° C. (about 70° F.), a solvent with a slow evaporation rate would evaporate too slowly and would be undesirable in the basecoat. Similarly, if the refinish basecoat is to be sprayed at high temperatures, such as higher than 32° C. (about 90° F.), a solvent with a fast evaporation rate would evaporate too quickly for the coating to flow over the automobile and achieve a smooth finish.

Accordingly, it is desirable to provide methods for making systems for producing a plurality of coating compositions with predetermined VOC contents that are suitable for use in predetermined temperature ranges. In addition, it is desirable to provide methods for producing such coating compositions. It also is desirable to provide systems for producing a plurality of such coating compositions. Furthermore, other desirable features and characteristics will become apparent from the subsequent detailed description and the appended claims, taken in conjunction with the accompanying drawings and this background.

BRIEF SUMMARY

Methods for making coating compositions that have predetermined VOC contents, methods for making systems for producing such coating compositions, and temperature adjusters for making such coating compositions are provided. In accordance with an exemplary embodiment, a method of making a coating composition includes selecting a temperature adjuster based on an ambient temperature at which application of the coating composition is to occur. The temperature adjuster contains a resin and a solvent, wherein the resin, the solvent, and/or amounts of the resin and the solvent are based on the ambient temperature. The temperature adjuster comprises no less than 1% solids. The temperature adjuster has no more than a predetermined VOC content. A paint is combined with the temperature adjuster. The paint contains a resin and a solvent and has no more than the predetermined VOC content. The temperature adjuster and the paint are mixed to form the coating composition, wherein the coating composition has no more than the predetermined VOC content.

In accordance with another exemplary embodiment, a method of making a system for producing a coating composition having a predetermined VOC content includes selecting an ambient temperature range at which a coating composition will be applied to a substrate and selecting an exempt solvent, a nonexempt solvent, and a resin from which to form a temperature adjuster used to make the coating composition. The exempt solvent and the nonexempt solvent are selected based on their rates of evaporation within the ambient temperature range. The amounts of the exempt solvent, the nonexempt solvent, and the resin are determined so that the temperature adjuster will be formed with the predetermined VOC content or less. The amounts of the exempt solvent, the nonexempt solvent and the resin are determined to form the temperature adjuster having the predetermined VOC content or less, wherein the temperature adjuster has no less than 1% solid. The selecting steps, the determining step and the mixing step are repeated to make additional temperature adjusters suitable for making additional coating compositions.

In accordance with a further exemplary embodiment, a temperature adjuster for making a coating composition is provided. The temperature adjuster has a predetermined VOC content and comprises no less than 1% solids. The temperature adjuster is formed by selecting an ambient temperature range at which the coating composition will be applied. An exempt solvent, a nonexempt solvent, and a resin from which to form the temperature adjuster used to make the coating composition are selected. The exempt solvent and the nonexempt solvent are selected based on their rates of evaporation within the ambient temperature range. Amounts of the exempt solvent, the nonexempt solvent, and the resin are determined so that the temperature adjuster will be formed with the predetermined VOC content or less. The amounts of the exempt solvent, the nonexempt solvent and the resin are mixed to form the temperature adjuster having the predetermined VOC content or less.

DETAILED DESCRIPTION

The following detailed description is merely exemplary in nature and is not intended to limit the various embodiments

or the application and uses thereof. Furthermore, there is no intention to be bound by any theory presented in the preceding background or the following detailed description.

Various embodiments for methods of making systems for producing a plurality of coating compositions having a predetermined VOC content, methods for making coating compositions having a predetermined VOC content, and temperature adjusters for making such coating compositions are described herein. The systems are manufactured for producing a plurality of coating compositions having a predetermined VOC content. As used herein, when a component has a "predetermined VOC content," the component has a VOC content that is selected prior to the component being manufactured. In this regard, the component is manufactured so that it has the selected VOC content. For example, the predetermined VOC content can be selected from the range of from about 0.21 kilograms (kg) of VOCs/liter (l) of component to about 0.48 kg/l (about 1.8 to about 4.0 pounds (lb.) of VOCs/gallon (gal.) of component), for example, in the range of from about 0.25 kg/l component to about 0.45 kg/l (about 2.1 lbs./gal to about 3.8 lbs./gal), such as about 0.34 kg/l of component to 0.42 kg/l (about 2.8 lbs./gal to about 3.5 lbs./gal).

The systems generally include a paint that has the predetermined VOC content or less. In addition, the systems contain a plurality of temperature adjusters that each has a balance of solvents and resins. As used herein, the term "resin" means any of a class of nonvolatile, solid or semi-solid organic substances that may consist of amorphous mixtures of natural oil obtained directly from certain plants as exudations, or resins prepared by polymerization of simple molecules. Suitable resins include, but are not limited to, acrylic resins, polyester resins, and cellulosic resins common in the art. Particularly useful hydroxyl-containing acrylic polymers are composed of polymerized monomers of alkyl methacrylates and alkyl acrylates, each having 1-12 carbon atoms in the alkyl groups, isobornyl methacrylate, isobornyl acrylate, hydroxyl alkyl methacrylate and hydroxyl alkyl acrylate, each having 1-4 carbon atoms in the alkyl group, styrene or any mixture of any of the above monomers. These acrylic polymers have a weight average molecular weight of about 2,000 to about 50,000 and a glass transition temperature (Tg) of from about −20° C. to about 100° C. Useful polyesters are the esterification product of one or more aliphatic or aromatic polycarboxylic acids, and one or more aliphatic polyols, but may also incorporate anhydrides, monoacids, monoalcohols, or lactones. Useful carboxylic acid or anhydride components include aliphatic diacids having 0-12 carbon atoms between the acid groups, phthalic anhydride, isophthalic acid, terephthalic acid, hexahydrophthalic anhydride, benzoic acid, and coconut fatty acid. Useful hydroxyl components include aliphatic glycols having 0-6 carbon atoms between the hydroxyl groups, glycerine, trimethylolpropane, pentaerythritol, dimethylolpropionic acid, cyclohexanol, and epsilon-caprolactone. The suitable polyester has a weight average molecular weight ranging from about 1500 to about 20,000 and a Tg in the range of about −50° C. to about 100° C. Useful cellulosic resins include the cellulose acetate butyrate types and the cellulose acetate propionate types. The resins permit the temperature adjusters to be formulated such that non-exempt solvents may be used in the temperature adjusters while each of the temperature adjusters still meet the predetermined VOC content or less. Each temperature adjuster has a different solvent or mixture of solvents or an amount of solvent(s) so that the resulting coating composition is suitable for film application, film formation, leveling, and drying within a predetermined ambient temperature range. In this regard, a coating composition can be formulated to meet a predetermined VOC content or less and to exhibit a suitable application, film formation, leveling and drying performance for a given ambient temperature.

In accordance with an exemplary embodiment, a method for making a system for producing a plurality of coating compositions having a predetermined VOC content includes preparing a paint having the predetermined VOC content or less and preparing a plurality of temperature adjusters, each having the predetermined VOC content or less. As used herein, the term "coating composition" is used to mean any type of coating applied to a substrate. The substrate can be made of metal, plastic or other polymer materials, wood, ceramic, clay, concrete, stone, or other man-made or natural materials. Examples of suitable substrates include, but are not limited to, a vehicle, such as an automobile or truck; a home appliance, such as a refrigerator, a washing machine, a dishwasher, microwave oven, cooking and baking ovens; electronic appliances, such as television sets, computers, electronic game sets, audio and video equipment, recreational equipment, such as bicycles, ski equipment, and all-terrain vehicles; and home or office furniture, such as tables and file cabinets. The substrate can also have one or more existing coating layers. The coating compositions can include primers, sealers, topcoats, clear-coats, basecoats, one- and two-stage coatings, and the like. As used herein, the term "paint" refers to a composition with or without pigment. In the context of vehicle coating, the coating composition can be used both for vehicle original equipment manufacturing (OEM) coatings and for repairing or refinishing coatings of vehicles and vehicle parts.

In an exemplary embodiment, the paint is formed from resins and solvents. The resins are selected depending, at least in part, on the purpose of the coating composition. For example, if the coating composition is to be a clear coating, a resin of the paint may provide, at least in part, an abrasion-resistance function. The solvents in the paint will include exempt and non-exempt solvents. The relationship between the VOC content and the type and amount of resins and solvents in the paint can be based on a formula, such as that provided by government regulations. For example, in the United States, when VOC-exempt solvents are involved, the following Equation I is used for a given volume of paint:

$$VOC \text{ content (kg/l)} = \frac{(\text{kgs total solvent} - \text{kgs exempt solvents})}{(\text{total liters of paint} - \text{liters of exempt solvents})}, \quad \text{(I)}$$

where water is also considered an exempt solvent. If the paint contains resins and solvents and other solids, the Equation I becomes:

$$VOC \text{ content (kg/l)} = \frac{\left(\begin{array}{c}\text{kgs exempt solvent} + \\ \text{kgs nonexempt solvent} - \text{kgs exempt solvents}\end{array}\right)}{\left(\begin{array}{c}\text{l. nonexempt solvent} + \text{l. exempt solvent} + \\ \text{l. resin solids} + \text{l. other solids} - \text{l. exempt solvents}\end{array}\right)},$$

where kgs means kilograms and l. means liters. When simplified, Equation I becomes:

$$VOC \text{ content} = \frac{(\text{kgs nonexempt solvent})}{(\text{l. nonexempt solvent} + \text{l. resin solids} + \text{l. other solids})}.$$

Thus, as explained in more detail below, if nonexempt solvents are desired in the paint, for example, for their functionality, adding resin to the paint will decrease the VOC content.

In an exemplary embodiment, the paint is formed using a tint. The tint can be packaged as a first component of the system. In one embodiment, the tint has the same predetermined VOC content of the coating composition or has a lower VOC content. In an alternative embodiment, the tint has a VOC content that is higher than the predetermined VOC content. The tint can include a conventional organic or inorganic colored pigment or mixture of pigments that will provide the coating composition with a desired color or special effect selected by a user. Metallic flakes, such as aluminum flakes, special effect pigments, such as coated mica flakes, coated aluminum flakes, or a combination thereof can also be used. The tint is produced by combining the pigments with resins and solvents. The resins can be of the general class of acrylics, polyesters, alkyds and the like and provide the functions of wetting the pigment, aiding in grinding, and facilitating paint compatibility. The solvents are VOC-exempt and non-exempt and can include ketones, such as acetone, methyl ethyl ketone, methyl isobutyl ketone, methyl amyl ketone, methyl isoamyl ketone, and diisobutyl ketone, esters, such as, ethyl acetate, n-butyl acetate, t-butyl acetate, isobutyl acetate, amyl acetate, and ethyl 3-ethoxy propionate, alcohols such as, ethanol, isopropanol, butanol, pentanol, glycol ethers, such as propylene glycol methyl ether, propylene glycol monomethyl ether acetate, propylene glycol monobutyl ether acetate, aromatic hydrocarbons, such as toluene, xylene, and aromatic 100 or aliphatic hydrocarbons, such as heptane, petroleum naphtha, and VM&P naptha (varnish makers and painter naptha). The tint also may include dispersant polymers of the acrylic and/or polyester type with polar, ionic, aromatic, basic, or acidic functional groups. The dispersant polymers are selected for various functions, for example, wetting and/or stabilizing the pigments in the tint. The tint further may include additives such as rheology-imparting materials such as bentonite clays or hydrophobic fumed silica to prevent settling and improve suspension of the pigments. If it is desirable for the tint to have the same predetermined VOC content of the coating composition or have a lower VOC content, the various ingredients and amounts of the tint can be selected and calculated using Equation (I) for the total liters of tint. Alternatively, another suitable VOC content formula that determines the VOC content from VOC exempt and non-exempt solvents and resins can be used.

In an embodiment, the tint is prepared by mixing the pigment, the resins, the solvents, and the dispersants into a mixture. The mixture also may be processed through a grinding mill to grind down the pigment to a fine particle size and coat the pigment particles with the resins and the solvents. Additional resins, solvents and additives then are added to the pigment dispersion to produce the final stable pigment concentration.

In another embodiment, the paint is formed using a binder solution. The binder solution can be packaged as a second component of the system. In an embodiment, the binder solution has the same predetermined VOC content of the coating composition or has a lower VOC content. In an alternative embodiment, the binder solution has a VOC content that is higher than the predetermined VOC content of the coating composition. The binder solution contains, in addition to solvents, binder resins. When a tint is used in the paint, depending on the particular color of the pigment, the binder resins are used to further adjust concentration of the pigment in the coating composition. In addition, the binder adjuster can include additives, such as those usually used in the paint industry. Examples of such additives are light stabilizers, for example, based on benztriazoles and HALS compounds, flow control agents based on (meth)acrylic homopolymers or silicone oils, rheology-influencing agents, such as hydrophobic fumed silica or polymeric urea compounds, thickeners, such as cross-linked polycarboxylic acid or polyurethanes, anti-foaming agents, wetting agents, and the like. Examples of general chemical classes of suitable resins for use in the binder solution include, but are not limited to, acrylic resins, polyester resins and cellulosic resins common to the art. Particularly useful hydroxyl-containing acrylic polymers are composed of polymerized monomers of alkyl methacrylates and alkyl acrylates, each having 1-12 carbon atoms in the alkyl groups, isobornyl methacrylate, isobornyl acrylate, hydroxyl alkyl methacrylate and hydroxyl alkyl acrylate, each having 1-4 carbon atoms in the alkyl group, styrene or any mixture of any of the above monomers. These acrylic polymers have a weight average molecular weight of about 2,000 to about 50,000 and a Tg of from about −20° C. to about 100° C. Useful polyesters are the esterification product of one or more aliphatic or aromatic polycarboxylic acids, and one or more aliphatic polyols, but may also incorporate anhydrides, monoacids, monoalcohols, or lactones. Useful carboxylic acid or anhydride components include aliphatic diacids having 0-12 carbon atoms between the acid groups, phthalic anhydride, isophthalic acid, terephthalic acid, hexahydrophthalic anhydride, benzoic acid, and coconut fatty acid. Useful hydroxyl components include aliphatic glycols having 0-6 carbon atoms between the hydroxyl groups, glycerine, trimethylolpropane, pentaerythritol, dimethylolpropionic acid, cyclohexanol, and epsilon-caprolactone. The suitable polyester has a weight average molecular weight ranging from about 1500 to about 20,000 and a Tg in the range of about −50° C. to about 100° C. Useful cellulosic resins include the cellulose acetate butyrate types and the cellulose acetate propionate types. The solvents are VOC-exempt and non-exempt and can include ketones, such as acetone, methyl ethyl ketone, methyl isobutyl ketone, methyl amyl ketone, methyl isoamyl ketone, and diisobutyl ketone, esters, such as, ethyl acetate, n-butyl acetate, t-butyl acetate, isobutyl acetate, amyl acetate, and ethyl 3-ethoxy propionate, alcohols such as, ethanol, isopropanol, butanol, pentanol, glycol ethers, such as propylene glycol methyl ether, propylene glycol monomethyl ether acetate, propylene glycol monobutyl ether acetate, aromatic hydrocarbons, such as toluene, xylene, and aromatic 100, or aliphatic hydrocarbons, such as heptane, petroleum naphtha, and VM&P naptha. If it is desirable for the binder solution to have the same predetermined VOC content of the coating composition or have a lower VOC content, the various ingredients and amounts of the binder solution can be selected and calculated using Equation (I) for the total liters of binder solution. Alternatively, another suitable VOC content formula that determines the VOC content from VOC exempt and non-exempt solvents and resins can be used.

The paint also is prepared using a reducer, according to another embodiment. The reducer can be packaged as a third component of the system. In an embodiment, the reducer has the same predetermined VOC content of the coating composition or has a lower VOC content. In an alternative embodiment, the reducer has a higher VOC content than the predetermined VOC content of the coating composition. The reducer is predominantly solvent, such as, for example, all exempt solvents, and is used to further dilute the pigment

and/or functional resins in the tint and/or the binder solution. In the case where the non-VOC exempt solvent content of the chosen reducer is already relatively low, merely by adding a small amount of resin to the solvent of the reducer, the VOC content of the reducer can be reduced so that the VOC content of the reducer achieves the predetermined VOC content or less. The solvents are VOC-exempt and non-exempt and can include ketones, such as acetone, methyl ethyl ketone, methyl isobutyl ketone, methyl amyl ketone, methyl isoamyl ketone, and diisobutyl ketone, esters, such as, ethyl acetate, n-butyl acetate, t-butyl acetate, isobutyl acetate, amylacetate, and ethyl 3-ethoxy propionate, alcohols such as, ethanol, isopropanol, butanol, pentanol, glycol ethers, such as propylene glycol methyl ether, propylene glycol monomethyl ether acetate, propylene glycol monobutyl ether acetate, aromatic hydrocarbons, such as toluene, xylene, and aromatic 100 or aliphatic hydrocarbons, such as heptane, petroleum naptha, and VM&P naptha. Suitable resins include, but are not limited to, very low VOC acrylic resins, or polyesters resins, or flow-imparting resins such as acrylic or polyester plasticizers. In one embodiment, the reducer is about 96 wt. % solvent. In another embodiment, the reducer is about 98 wt. % solvent. In another embodiment, the reducer is 100 wt. % solvent. If it is desirable for the reducer to have the same predetermined VOC content of the coating composition or have a lower VOC content, the various ingredients and amounts of the reducer can be selected and calculated using Equation (I) for the total liters of reducer. Alternatively, another suitable VOC content formula that determines the VOC content from VOC exempt and non-exempt solvents and resins can be used.

In an embodiment, the tint, the binder solution, and/or the reducer are combined, in any suitable ratio and in any sequence, to form the paint. The paint can be mixed using any suitable method to combine the ingredients, such as high shear mixing, stirring, agitation, blending, or any combination thereof. In one embodiment, where each component has the predetermined VOC content or less, the components can be blended according to a predetermined formula or recipe to achieve a desired color or for a particular functional application (i.e., as a primer, a clearcoat, etc.) and still result in a paint with the predetermined VOC content. While in one embodiment, the paint is formed by combining the tint, the binder solution, and the reducer, it will be appreciated that the solvents, the resins, and other ingredients of these three components may not necessarily be separated into three such components but may be divided among two components or four or more components and then may be mixed together to form the paint. For example, when the paint is a clearcoat and no pigment will be used in a tint, the resins and solvents that would normally be used in the tint can be used in the binder solution, and only the binder solution and the reducer would be combined to form the paint.

As noted above, the method for making a system for producing a coating composition having a predetermined VOC content also includes preparing a plurality of temperature adjusters, each having the predetermined VOC content or less. The temperature adjusters can be packaged as a fourth component of the system. The function of the temperature adjusters is to further dilute the paint to the extent suitable for application, and to complete the full resin composition to achieve the desired color balance, enhance adhesion, improve rheology, speed drying, and the like. During application of a coating composition, it is preferable that the coating composition dry quickly but not so quickly that the basecoat does not have time to flow evenly over the substrate. Also as mentioned above, in the United States, there are relatively few exempt solvents and they do not necessarily have evaporation rates that make them suitable for use in all temperature ranges. This limited number of exempt solvents makes forming temperature adjusters that meet low VOC content limits difficult. Accordingly, the system for producing a coating composition is made with several temperatures adjusters, each temperature adjuster containing a solvent or mixture of solvents or an amount of solvent(s) that are preferable for use in a coating composition for application at a prescribed temperature range. For example, the system may be manufactured to include three temperature adjusters. A first temperature adjuster may be suitable to make a coating composition for application at temperatures in the range of from about 15° C. to about 24° C. (about 59° F. to about 75° F.), a second temperature adjuster may be suitable to make a coating composition for application at temperatures in the range of from about 24° C. to about 32° C. (75° F. to about 90° F.), and a third temperature adjuster may be suitable to make a coating composition for application at temperatures above about 32° C. (about 90° F.). Of course, the system may contain two, four or more temperature adjusters in other embodiments.

Solvents selected for use within the various temperature ranges may not be exempt solvents and, thus, are likely to have VOC contents beyond the predetermined VOC content. Accordingly, Equation I above, or another suitable VOC content formula, can be used to determine the amount of resins to be used in the temperature adjusters to achieve the predetermined VOC content or less. The resins themselves can be selected based on their functionality, such as their ability to balance color, enhance adhesion, improve rheology, speed drying, and the like. Resins that are not themselves packaged with non-exempt solvents, that is, that will not add non-exempt solvents with their own addition, are particularly suitable for use in the temperature adjusters. For example, powdered resins are preferred. The solvents are VOC-exempt and non-exempt and can include ketones, such as acetone, methyl ethyl ketone, methyl isobutyl ketone, methyl amyl ketone, methyl isoamyl ketone, and diisobutyl ketone, esters, such as, ethyl acetate, n-butyl acetate, t-butyl acetate, isobutyl acetate, amyl acetate, and ethyl 3-ethoxy propionate, alcohols such as, ethanol, isopropanol, butanol, pentnol, glycol ethers, such as propylene glycol methyl ether, propylene glycol monomethyl ether acetate, propylene glycol monobutyl ether acetate, aromatic hydrocarbons, such as toluene, xylene, and aromatic 100, or aliphatic hydrocarbons, such as heptane, petroleum naptha, and VM&P naptha. Suitable resins include, but are not limited to, acrylic resins, polyester resins, and cellulosic resins common to the art. Particularly useful hydroxyl-containing acrylic polymers are composed of polymerized monomers of alkyl methacrylates and alkyl acrylates, each having 1-12 carbon atoms in the alkyl groups, isobornyl methacrylate, isobornyl acrylate, hydroxyl alkyl methacrylate and hydroxyl alkyl acrylate, each having 1-4 carbon atoms in the alkyl group, styrene or any mixture of any of the above monomers. These acrylic polymers have a weight average molecular weight of about 2,000 to about 50,000 and a Tg of from about −20° C. to about 100° C. Useful polyesters are the esterification product of one or more aliphatic or aromatic polycarboxylic acids, and one or more aliphatic polyols, but may also incorporate anhydrides, monoacids, monoalcohols, or lactones. Useful carboxylic acid or anhydride components include aliphatic diacids having 0-12 carbon atoms between the acid groups, phthalic anhydride, isophthalic acid, terephthalic acid, hexahydrophthalic anhy-

dride, benzoic acid, and coconut fatty acid. Useful hydroxyl components include aliphatic glycols having 0-6 carbon atoms between the hydroxyl groups, glycerine, trimethylolpropane, pentaerythritol, dimethylolpropionic acid, cyclohexanol, and epsilon-caprolactone. The suitable polyester has a weight average molecular weight ranging from about 1500 to about 20,000 and a ϵ in the range of about −50° C. to about 100° C. Useful cellulosic resins include the cellulose acetate butyrate types and the cellulose acetate propionate types. The temperature adjusters further may include additives, such as those usually used in the paint industry. Examples of such additives are light stabilizers, for example, based on benztriazoles and HALS compounds, flow control agents based on (meth)acrylic homopolymers or silicon oils, rheology-influencing agents, such as hydrophobic fumed silica or polymeric urea compounds, thickeners, such as cross-linked polycarboxylic acid or polyurethanes, anti-foaming agents, wetting agents, and the like. The amount of resins and solvents in each of the temperature adjusters are such that each of the temperature adjusters has no less than about 1 wt. % solids based on the entire weight of the temperature adjuster, for example, no less than about 4% solids, such as no less than about 6% solids.

In another, optional, embodiment, the method for making a system for producing a plurality of coating compositions having a predetermined VOC content includes providing a crosslinking component in the system. The crosslinking component can be packaged as an optional, fifth component of the coating composition. The term "crosslinking component" refers to a component having "crosslinking functional groups" that are functional groups positioned in each molecule of the component, wherein these functional groups are capable of crosslinking with other functional groups in the coating composition (during the curing step) to produce a coating in the form of crosslinked structures.

Suitable crosslinking functional groups can include isocyanate, thioisocyanate, alkylated melamine formaldehyde, acetoacetoxy, carboxyl, primary amine, secondary amine, epoxy, anhydride, ketamine, aldimine, or a workable combination thereof. In an exemplary embodiment, the crosslinking component is polyisocyanate.

In another exemplary embodiment, a system for producing a plurality of coating compositions contains the tint, the binder solution, the reducer, the plurality of temperature adjusters, and the optional crosslinking component, as contemplated above, all packaged together and/or sold together and/or otherwise formulated or manufactured to be combined to produce a coating composition as contemplated herein. In another embodiment, the system is packaged with a plurality of tints so that coating compositions of a variety of colors and special effects can be produced using the binder solution, the reducer, the plurality of temperature adjusters, and the optional crosslinking component.

In a further exemplary embodiment, a method of making a coating composition includes forming a paint. The paint is formed by combining a binder solution, a reducer, and optionally a tint, as contemplated above, in amounts or ratios and sequence according to a predetermined formula for obtaining a coating composition having a predetermined color, special effect, or function. The paint can be mixed using any suitable method to combine the ingredients, such as high shear mixing, stirring, agitation, blending, or any combination thereof. While in one embodiment, the paint is formed by combining the tint, the binder solution, and the reducer, it will be appreciated that the solvents, the resins, and other ingredients of these three components may not necessarily be separated into three such components but may be divided among two components or four or more components and then may be mixed together to form the paint. For example, for a clearcoat, pigment in the tint may not be used. Accordingly, other necessary resins and solvents in the tint can be divided between the binder solution and the reducer and the paint can be formed from just these two components.

The method further includes selecting a temperature adjuster from a plurality of temperature adjusters based on the temperature at which the resulting coating composition will be applied. Application of the coating composition can be accomplished at ambient temperatures, such as temperatures in a range of from about 18° C. to about 43° C. Thus, as described above, for ambient temperatures in a range of from about 18° C. to about 35° C., a first temperature adjuster may be suitable to make a coating composition for application at temperatures in the range of from below about 24° C. (about 75° F.), a second temperature adjuster may be suitable to make a coating composition for application at temperatures in the range of from 24° C. to about 32° C. (75° F. to about 90° F.), and a third temperature adjuster may be suitable to make a coating composition for application at temperatures above about 32° C. (about 90° F.). Of course, the system may contain two, four or more temperature adjusters in other embodiments.

Once the temperature adjuster is selected for the temperature at which the coating composition is to be applied, the method continues with the mixing of the paint and the temperature adjuster. The paint and temperature adjuster are combined in amounts or ratios according to the predetermined formula for obtaining a coating composition having a predetermined color, special effect, or function. For example, the paint and the temperature adjuster can be combined in a predetermined ratio in the range of from about 4:1 to about 1:4 by volume, for example, from about 2:1 to about 1:2 by volume. The paint can be mixed using any suitable method to combine the ingredients, such as high shear mixing, stirring, agitation, blending, or any combination thereof. In an exemplary embodiment, the tint, the binder solution, the reducer and each of the temperature adjusters have a VOC content at the predetermined VOC content or less. In another embodiment, the tint, the binder solution, the reducer and/or the temperature adjusters have a VOC content above the predetermined VOC content but their presence in the coating composition is substantially insignificant such that the resulting coating composition still exhibits the predetermined VOC content or less. Thus, an end-user, such as an autobody refinisher, need not worry about meeting country or local VOC regulations upon formulating the coating composition as any coating composition created using the system will meet such regulations. An optional crosslinking component can also be added to the coating composition to facilitate crosslinking of the composition.

Next, the coating composition is applied to a substrate and dried. The coating composition can be applied by conventional techniques, such as spraying, electrostatic spraying, dipping, brushing, and flow coating. The coating composition can be applied to a thickness in the range of from about 2.54 microns (μm) to about 254 μm (about 0.1 to about 10 mils), for example, from about 12.7 μm to about 76.2 μm (about 0.5 to about 3 mils), and any number of coatings can be applied. Because the coating composition contains a temperature adjuster formulated to facilitate application, leveling, film formation, and drying at the temperature at which application is occurring, the coating composition dries (or cures, as the case may be) relatively quickly and evenly.

While the above embodiments describe the coating composition formed with the paint combined with a temperature adjuster, it is important to note that the coating composition is not so limited. Rather, the coating composition can be formed, in other embodiments, with the temperature adjuster combined first with one or more individual components of the paint, such as with the tint, the binder solution, or the reducer, followed by combination with the remaining components.

The following is an example of a refinish basecoat system, a method for making the system, and a method for producing a silver coating composition having a VOC content less than 0.42 kg/l (3.5 lb/gal). The examples are provided for illustration purposes only and are not meant to limit the various embodiments contemplated herein in any way.

EXAMPLES

Acrylic Resin #1

An acrylic polymer solution was prepared by free-radical copolymerization by charging the following constituents into a polymerization reactor equipped with a thermometer, a heating source, a stirrer, a dropping funnel, a nitrogen purge, and a condenser:

	wt. %
Portion 1	
Methyl amyl ketone	27.42
Portion 2	
Butyl acrylate monomer	31.00
Methacrylic acid monomer	5.00
Isobornyl acrylate monomer	20.00
Hydroxy ethyl methacrylate monomer	7.50
Hydroxy propyl methacrylate monomer	7.50
Styrene monomer	29.00
Portion 3	
Di-t-butyl-peroxide	0.55
Methyl amyl ketone	30.85
TOTAL	158.82

Portion 1 was added to the reactor and heated to its reflux temperature. Portion 2 was premixed and then added at a uniform rate to the reactor over 195 minutes while the resulting reaction mixture was maintained at its reflux temperature. Portion 3 was premixed and added to the reactor over a period of 200 minutes at a uniform rate while maintaining the reaction mixture at its reflux temperature. The reaction mixture was held at its reflux temperature for an additional 2 hours.

The resulting acrylic polymer solution had a polymer solids content of about 63 wt. % and a Gardner-Holdt viscosity of Z.

Acrylic Resin #2

An acrylic polymer solution was prepared by free-radical copolymerization by charging the following constituents into a polymerization reactor equipped with a thermometer, a heating source, a stirrer, a dropping funnel, a nitrogen purge, and a condenser:

	wt. %
Portion 1	
T-butylacetate	13.70
Portion 2	
Methyl methacrylate monomer	14.60
N-butyl acrylate monomer	14.60
2-Ethylhexyl methacrylate monomer	11.70
Hydroxy ethyl methacrylate monomer	11.70
Styrene monomer	5.90
T-butylacetate	1.20
Portion 3	
Vazo ® 67	3.40
T-butylacetate	23.20
TOTAL	158.82,

where Vazo® 67 is 2,2'azobis-(2-methylbutyronitrile available from E.I. DuPont de Nemours and Co., Wilmington, Del. Portion 1 was added to the reactor and heated to its reflux temperature. Portion 2 was premixed and then added at a uniform rate to the reactor over 360 minutes while the resulting reaction mixture was maintained at its reflux temperature. Portion 3 was premixed and simultaneously added to the reactor with Portion 2. Portion 3 was added over a period of 390 minutes. The reaction mixture was held at its reflux temperature for an additional 60 minutes and then cooled to room temperature. The resulting acrylic polymer solution had a polymer solids content of about 60 wt. % and a Gardner-Holdt viscosity Y+1/4.

Rheology Control Agent in Acrylic Resin #2

Approximately 1.7 wt. % of benzyl amine, available from BASF of Florham Park, N.J., was mixed with about 1.34 wt. % of 1.6 hexamethylene diisocyanate in the presence of 96.36 wt. % of the Acrylic Resin #2. The reaction was stirred for 5 minutes.

Polyester Resin

A copolyester polyol was synthesized by esterifying dimethylolpropionic acid, pentaerythritol, and epsilon-caprolactone. A 12-liter reactor equipped with a mechanical stirrer, a thermocouple, and a short path distillation head with a water separator under nitrogen purge was charged with 2063.4 g. dimethylolpropionic acid (DMPA), 167.1 g. pentaerythritol (PE), 31.0 g. tin (II) 2-ethylhexanoate, and 108.3 g. xylene. The reaction mixture was heated to its reflux temperature and the water of reaction was collected from the water separator. The reaction progress was monitored by the amount of water collected, and the reaction temperature was not allowed to exceed 185° C. An additional 20 g of xylene was added throughout the reaction to maintain the reflux temperature below 185° C. When the amount of water collected approached theoretical (277 g), acid number measurements were used to determine the end point, which was an acid number of less than 5. At a measured acid number of 1.7, the reactor was allowed to cool to 120° C. Then 4126.8 g of epsilon-caprolactone was added slowly over a 15-20 minute period through an addition funnel. The reactor was held at 120° C. until the solids exceeded 95%. Then the reactor was allowed to cool to 90° C. and the resulting polymer solution was thinned with 1391.8 g methyl amyl ketone. Forced air was used to cool the reactor to below 50° C.

The polymer solution had 80.2 wt. % solids content, a Gardner Holdt viscosity of V+1/4, and the final acid number was 2.1 corrected for solids. The Polyester Resin was further reduced to 65.5 wt. % solids content by the further addition of methyl amyl ketone.

The various components of a paint of the silver coating composition were then produced according to the following formulas and with the relative predetermined VOC contents:

Aluminum Tint	
	(wt. %)
Acrylic resin #1	27.192
Acrylic resin #2	20.752
Aluminum paste 7768N from Toyo Aluminum	23.845
Dispersion of Bentone 27 clay from Elementis Specialties, Inc.	14.286
Methyl amyl ketone	5.000
Ethyl 3-ethoxy propionate	4.100
t-Butyl acetate	4.825
TOTAL	100.000,

where Aluminum past 7768N is available from Toyo Aluminum K.K. of Japan and Bentone 27 clay is available from Element is Specialties, Inc. of East Windsor, N.J.

VOC content =

$$\frac{(1.982 \text{ kg total solvent} - 0.806 \text{ kg exempt solvent})}{(3.785\ 1 - 0.939\ 1 \text{ exempt solvent})} = 0.413 \text{ kg/l.}$$

Binder Solution	
	(wt. %)
Acrylic resin #1	31.638
Acrylic resin #2	21.548
Ethyl 3-ethoxy propionate	10.900
t-Butyl acetate	35.914
TOTAL	100.000

VOC content =

$$\frac{(2.366 \text{ kg total solvent} - 1.562 \text{ kg exempt solvent})}{(3.785\ 1 - 1.813\ 1 \text{ exempt solvent})} = 0.408 \text{ kg/l.}$$

Reducer #1 (At or Below Predetermined VOC Content)	
	(wt. %)
t-Butyl acetate	98.919
Acrylic resin #2	1.081
TOTAL	100.000

VOC content =

$$\frac{(3.243 \text{ kg total solvent} - 3.227 \text{ kg exempt solvent})}{(3.785\ 1 - 3.745\ 1 \text{ exempt solvent})} = 0.400 \text{ kg/l.}$$

Reducer #2 (Above Predetermined VOC Content)	
	(wt. %)
t-Butyl acetate	100.000
TOTAL	100.000

VOC content =

$$\frac{(3.260 \text{ kg total solvent} - 3.244 \text{ kg exempt solvent})}{(3.785\ 1 - 3.764\ 1 \text{ exempt solvent})} = 0.762 \text{ kg/l.}$$

Temperature Adjuster No. 1 (Temp. Range about 18 to 27° C.)	
	(wt. %)
SCA in Acrylic Resin #2	2.729
Polyester Resin	1.855
CAB resin 381-0.5	1.932
CAB resin 381-0.1	1.123
Resamin ® HF480	0.500
Byk ® 361N	0.167
Diisobutyl ketone	2.200
Ethyl 3-ethoxy propionate	1.570
Acetone	6.110
Benzene, 1-chloro-4(trifluoromethyl)	81.814
TOTAL	100.000,

where CAB resin 381-0.5 and 381-0.1 are cellulose acetate butyrates available from Eastman Chemical Co. of Kingsport, Tenn., Resamin HF480 is a carbamic resin available from Allnex of Belgium, and Byk® 361N is a polyacrylate surface additive available from Byk of Germany.

VOC content =

$$\frac{(4.371 \text{ kg total solvent} - 4.161 \text{ kg exempt solvent})}{(3.785\ 1 - 3.274\ 1 \text{ exempt solvent})} = 0.411 \text{ kg/l.}$$

Temperature Adjuster No. 2 (Temp. Range about 27 to 32° C.)	
	(wt. %)
SCA in Acrylic resin #2	1.772
Acrylic resin #2	0.963
Polyester resin	1.851
CAB resin 381-0.5	1.926
CAB resin 381-0.1	1.119
Resamin ® HF480	0.498
Byk ® 361N	0.166
Diisobutyl ketone	1.100
Ethyl 3-ethoxy propionate	1.035
Ethylene glycol monobutylether acetate	1.485
Acetone	6.091
Benzene, 1-chloro-4(trifluoromethyl)	81.994
TOTAL	100.000

VOC content =

$$\frac{(4.385 \text{ kg total solvent} - 4.182 \text{ kg exempt solvent})}{(3.785\ 1 - 3.293\ 1 \text{ exempt solvent})} = 0.413 \text{ kg/l.}$$

Temperature Adjuster No. 3 (Temp. Range about 32 to 40° C.)	
	(wt. %)
SCA in acrylic resin #2	0.814
Acrylic resin #2	1.926
Polyester resin	1.846
CAB resin 381-0.5	1.920
CAB resin 381-0.1	1.116
Resamin ® HF480	0.497
Byk ® 361N	0.165
Ethyl 3-ethoxy propionate	0.500
Ethylene glycol monobutylether acetate	2.970
Acetone	6.072
Benzene, 1-chloro-4(trifluoromethyl)	82.174
TOTAL	100.000

VOC content =

$$\frac{(4.398 \text{ kg total solvent} - 4.201 \text{ kg exempt solvent})}{(3.785\ 1 - 3.308\ 1 \text{ exempt solvent})} = 0.413 \text{ kg/l.}$$

Temperature Adjuster No. 4 (Temp. Range about 18 to 27° C.)	
	(wt. %)
SCA in Acrylic Resin #2	2.729
Polyester Resin	1.855
CAB resin 381-0.5	1.932
CAB resin 551-0.2	1.123
Resamin ® HF480	0.500
Byk ® 361N	0.167
Diisobutyl ketone	2.200
Ethyl 3-ethoxy propionate	1.570
Acetone	6.110
Benzene, 1-chloro-4(trifluoromethyl)	81.814
TOTAL	100.000,

where CAB resin 381-0.5 and 551-0.2 are cellulose acetate butyrates available from Eastman Chemical Co. of Kingsport, Tenn., Resamin HF480 is a carbamic resin available from Allnex of Belgium, and Byk® 361N is a polyacrylate surface additive available from Byk of Germany.

VOC content =

$$\frac{(4.368 \text{ kg total solvent} - 4.161 \text{ kg exempt solvent})}{(3.7875\ 1 - 3.279\ 1 \text{ exempt solvent})} = 0.409 \text{ kg/l.}$$

Temperature Adjuster No. 5 (Temp. Range about 18 to 27° C.)	
	(wt. %)
SCA in Acrylic Resin #2	2.729
Polyester Resin	1.855
CAB resin 381-0.5	1.932
CAB resin 381-2	1.123
Resamin ® HF480	0.500
Byk ® 361N	0.167
Diisobutyl ketone	2.200

-continued

Temperature Adjuster No. 5 (Temp. Range about 18 to 27° C.)	
	(wt. %)
Ethyl 3-ethoxy propionate	1.570
Acetone	6.110
Benzene, 1-chloro-4(trifluoromethyl)	81.814
TOTAL	100.000,

where CAB resin 381-0.5 and 381-2 are cellulose acetate butyrates available from Eastman Chemical Co. of Kingsport, Tenn., Resamin HF480 is a carbamic resin available from Allnex of Belgium, and Byk® 361N is a polyacrylate surface additive available from Byk of Germany.

VOC content =

$$\frac{(4.372 \text{ kg total solvent} - 4.162 \text{ kg exempt solvent})}{(3.785\ 1 - 3.279\ 1 \text{ exempt solvent})} = 0.415 \text{ kg/l.}$$

Temperature Adjuster No. 6 (Temp. Range about 18 to 27° C.)	
	(wt. %)
SCA in Acrylic Resin #2	3.981
Polyester Resin	4.003
CAB resin 381-0.5	3.415
Resamin ® HF480	0.711
Byk ® 361N	0.236
Diisobutyl ketone	5.237
Acetone	6.829
t-Butyl acetate	14.768
Benzene, 1-chloro-4(trifluoromethyl)	60.820
TOTAL	100.000,

where CAB resin 381-0.5 is cellulose acetate butyrate available from Eastman Chemical Co. of Kingsport, Tenn., Resamin HF480 is a carbamic resin available from Allnex of Belgium, and Byk® 361N is a polyacrylate surface additive available from Byk of Germany.

VOC content =

$$\frac{(3.842 \text{ kg total solvent} - 3.558 \text{ kg exempt solvent})}{(3.785\ 1 - 3.088\ 1 \text{ exempt solvent})} = 0.407 \text{ kg/l.}$$

Temperature Adjuster No. 7 (Temp. Range about 27 to 32° C.)	
	(wt. %)
SCA in Acrylic resin #2	3.797
Polyester resin	3.818
CAB resin 381-0.5	3.258
Resamin ® HF480	0.678
Byk ® 361N	0.227
Diisobutyl ketone	2.326
Ethyl 3-ethoxy propionate	2.344
Acetone	6.514
t-Butyl acetate	7.181
Benzene, 1-chloro-4(trifluoromethyl)	69.857
TOTAL	100.000

VOC content =

$$\frac{(4.047 \text{ kg total solvent} - 3.778 \text{ kg exempt solvent})}{(3.785 \text{ l} - 3.128 \text{ l exempt solvent})} = 0.409 \text{ kg/l.}$$

Temperature Adjuster No. 8 (Temp. Range about 32 to 40° C.)

	(wt. %)
SCA in acrylic resin #2	3.646
Polyester resin	3.667
CAB resin 381-0.5	3.126
Resamin ® HF480	0.650
Byk ® 361N	0.216
Ethylene glycol monobutylether	4.384
Acetone	6.253
Benzene, 1-chloro-4(trifluoromethyl)	78.058
TOTAL	100.000

VOC content =

$$\frac{(4.233 \text{ kg total solvent} - 3.970 \text{ kg exempt solvent})}{(3.785 \text{ l} - 3.143 \text{ l exempt solvent})} = 0.410 \text{ kg/l.}$$

Silver Basecoat Paint No. 1

	(wt. %)
Aluminum Tint	58.56
Binder Solution	20.05
Reducer #1	21.39
TOTAL	100.00

VOC content =

$$\frac{(2.372 \text{ kg total solvent} - 1.557 \text{ kg exempt solvent})}{(3.785 \text{ l} - 1.787 \text{ l exempt solvent})} = 0.408 \text{ kg/l.}$$

Reduced Silver Refinish Basecoat No. 1

	(wt. %)
Silver Basecoat Paint	28.35
Temperature Adjuster No. 1	71.65
TOTAL	100.00

VOC content =

$$\frac{(3.703 \text{ kg total solvent} - 3.293 \text{ kg exempt solvent})}{(3.785 \text{ l} - 2.780 \text{ l exempt solvent})} = 0.408 \text{ kg/l.}$$

Silver Basecoat Paint No. 2

	(wt. %)
Aluminum Tint	48.76
Binder Solution	6.01
Reducer #1	45.23
TOTAL	100.00

VOC content =

$$\frac{(2.6941 \text{ kg total solvent} - 2.065 \text{ kg exempt solvent})}{(3.785 \text{ l} - 2.380 \text{ l exempt solvent})} = 0.410 \text{ kg/l.}$$

Reduced Silver Refinish Basecoat No. 2

	(wt. %)
Silver Basecoat Paint No. 2	27.72
Temperature Adjuster No. 1	72.28
TOTAL	100.00

VOC content =

$$\frac{(3.794 \text{ kg total solvent} - 3.464 \text{ kg exempt solvent})}{(3.785 \text{ l} - 2.979 \text{ l exempt solvent})} = 0.409 \text{ kg/l.}$$

Silver Basecoat Paint No. 3

	(wt. %)
Aluminum Tint	37.45
Binder Solution	15.31
Reducer #2	47.24
TOTAL	100.00

VOC content =

$$\frac{(2.696 \text{ kg total solvent} - 2.172 \text{ kg exempt solvent})}{(3.785 \text{ l} - 2.507 \text{ l exempt solvent})} = 0.410 \text{ kg/l.}$$

Reduced Silver Refinish Basecoat No. 3

	(wt. %)
Silver Basecoat Paint No. 3	45.45
Temperature Adjuster No. 6	54.55
TOTAL	100.00

VOC content =

$$\frac{(3.269 \text{ kg total solvent} - 2.865 \text{ kg exempt solvent})}{(3.785 \text{ l} - 2.798 \text{ l exempt solvent})} = 0.409 \text{ kg/l.}$$

Accordingly, various embodiments for methods of making systems for producing a plurality of coating compositions having a predetermined VOC content, methods for making coating compositions having a predetermined VOC content, and temperature adjusters for making such coating compositions are described herein. While at least one exemplary embodiment has been presented in the foregoing detailed description of the invention, it should be appreciated that a vast number of variations exist. It should also be appreciated that the exemplary embodiment or exemplary embodiments are only examples, and are not intended to limit the scope, applicability, or configuration of the invention in any way. Rather, the foregoing detailed description will provide those skilled in the art with a convenient road map for implementing an exemplary embodiment of the invention. It being understood that various changes may be made in the function and arrangement of elements described in an exemplary embodiment without departing from the scope of the invention as set forth in the appended claims.

What is claimed is:

1. A method for making a coating composition, the method comprising the steps of:

selecting a temperature adjuster from a plurality of temperature adjusters based on an ambient temperature at which application of the coating composition is to occur, the temperature adjuster comprising a resin and a solvent, wherein the resin, the solvent, and/or amounts of the resin and the solvent are based on the ambient temperature, wherein the temperature adjuster comprises no less than about 1% solids and wherein the temperature adjuster comprises no more than a predetermined VOC content, wherein the predetermined VOC content is about 0.48 kilograms per liter;

combining a paint with the temperature adjuster, the paint comprising a resin and a solvent and having no more than the predetermined VOC content; and

mixing the temperature adjuster and the paint to form the coating composition, wherein the coating composition has no more than the predetermined VOC content, wherein the resin is selected from the group comprising acrylics, polyesters, and alkyds, and wherein the solvent is selected from the group comprising ketones, esters, alcohols, glycol ethers, aromatic hydrocarbons, and aliphatic hydrocarbons.

2. The method of claim **1**, wherein combining the paint with the temperature adjuster comprises combining the paint formed of a tint, wherein the tint comprises no more than the predetermined VOC content and contains a pigment.

3. The method of claim **1**, wherein combining the paint with the temperature adjuster comprises combining the paint formed of a binder solution, wherein the binder solution comprises no more than the predetermined VOC content and contains a resin and a solvent.

4. The method of claim **1**, wherein combining the paint with the temperature adjuster comprises combining the paint formed of a reducer, wherein the reducer comprises no more than the predetermined VOC content and contains a solvent with or without some resin.

5. The method of claim **1**, wherein mixing comprises mixing the temperature adjuster, the paint, and a crosslinking component.

6. The method of claim **5**, wherein mixing comprises mixing the temperature adjuster, the paint, and an isocyanate.

7. The method of claim **1**, wherein mixing comprises mixing the temperature adjuster and the paint in a ratio in a range of from about 4:1 to about 1:4.

8. The method of claim **7**, wherein mixing comprises mixing the temperature adjuster and the paint in a ratio in the range of from about 2:1 to about 1:2.

9. The method of claim **1**, wherein combining the paint with the temperature adjuster comprises combining the paint formed of a tint, a binder solution, and a reducer and one or more of the tint, the binder solution, and the reducer comprises no more than the predetermined VOC content.

10. The method of claim **1** wherein the temperature adjuster comprises no more than about 0.45 kilograms per liter.

11. The method of claim **1** wherein the temperature adjuster comprises no more than about 0.42 kilograms per liter.

12. The method of claim **1**, wherein the temperature adjuster comprises from about 0.21 kilograms of VOCs per liter to about 0.48 kilograms of VOCs per liter; and wherein the coating composition comprises from about 0.21 kilograms of VOCs per liter to about 0.48 kilograms of VOCs per liter.

13. The method of claim **12**, wherein the temperature adjuster comprises from about 0.25 kilograms of VOCs per liter to about 0.45 kilograms of VOCs per liter, and wherein the coating composition comprises from about 0.25 kilograms of VOCs per liter to about 0.45 kilograms of VOCs per liter.

14. The method of claim **12**, wherein the temperature adjuster comprises from about 0.34 kilograms of VOCs per liter to about 0.42 kilograms of VOCs per liter, and wherein the coating composition comprises from about 0.34 kilograms of VOCs per liter to about 0.42 kilograms of VOCs per liter.

15. The method of claim **12**, wherein the paint comprises from about 0.21 kilograms of VOCs per liter to about 0.48 kilograms of VOCs per liter.

16. The method of claim **12**, wherein combining the paint with the temperature adjuster comprises combining the paint formed of a tint, wherein the tint comprises from about 0.21 kilograms of VOCs per liter to about 0.48 kilograms of VOCs per liter and contains a pigment.

17. The method of claim **12**, wherein combining the paint with the temperature adjuster comprises combining the paint formed of a binder solution, wherein the binder solution comprises from about 0.21 kilograms of VOCs per liter to about 0.48 kilograms of VOCs per liter and contains a resin and a solvent.

18. The method of claim **12**, wherein combining the paint with the temperature adjuster comprises combining the paint formed of a reducer, wherein the reducer comprises from about 0.21 kilograms of VOCs per liter to about 0.48 kilograms of VOCs per liter and contains a solvent.

19. The method of claim **12**, wherein mixing comprises mixing the temperature adjuster and the paint in a ratio of from about 2:1 to about 1:2.

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